

REMARKS

Claims 1-24 are pending. Claims 5-17 stand withdrawn from further consideration as being directed to a non-elected invention.

Claim 1 is amended hereby. A marked-up version showing the changes made to claim 1 by the present amendment is attached hereto as **“VERSION WITH MARKINGS TO SHOW CHANGES MADE.”**

The drawings were objected to for failing to show layer 17 as described in the specification. A Request for Approval of Drawing Changes is filed herewith wherein the uppermost GaN optical guide layer is labeled by “17.” The Examiner is requested to review and approve the proposed drawing correction.

A Submission of Formal Drawings is also filed herewith. Upon receiving the Examiner’s approval if the amendment to Fig. 1, corrective formal drawings incorporating the requested change will be filed.

Claims 1-3 and 21-24 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Edmond et al.* in view of *Nakamura et al.* Favorable reconsideration of this rejection is earnestly solicited.

It is an object of the present invention to decrease the resistance at the interface between the substrate and the buffer layer. In order to achieve the object of the present invention, the present invention proposes the use of an AlGaN buffer layer of a specific composition in combination with an SiC substrate. In order to clarify this feature of the present invention, claim 1 has been amended to specify the location of the second electrode at the bottom surface of the substrate.

It is noted that *Nakamura et al.* teaches a structure in which the bottom electrode is provided on the bottom cladding layer. According to such a construction, injection of carriers does not take place through the interface between the substrate and buffer layer, and thus, the teaching of *Nakamura et al.* is irrelevant to the subject matter of claim 1 as now amended.

Further, it is noted that in *Edmond et al.* the injection of carriers is achieved directly to the bottom cladding layer 43 from the bottom electrode. Thus, *Edmond et al.* is also irrelevant to the subject matter of the present invention as set forth in amended claim 1. It is also noted that *Edmond et al.* clearly describes in column 7, line 40, that the buffer layer 42 is “insulating.”

Thus, both of *Nakamura et al.* and *Edmond et al.* are irrelevant to the subject matter of the present invention, and the subject matter of claim 1 is by no means derived from any of these references or from their combination.

With regard to claim 21, the carrier concentration in column 14, line 3 of *Nakamura et al.* is not for the buffer layer making direct contact with the substrate, but for the bottom cladding layer. Thus, *Nakamura et al.* is silent about the feature of the carrier concentration level in the buffer layer as set forth in claim 21. With regard to *Edmond et al.*, please note that the buffer layer 42 is AlN, not AlGaIn. As noted before, *Edmond et al.* clearly describes that the buffer layer 42 is insulating material. Further, the AlGaIn layer 45 of *Edmond et al.* is not a buffer layer, contrary to the present invention.

Thus, the subject matter of claim 21 is clearly distinguished over any of *Edmond et al.* and *Nakamura et al.* or their combination.

Claims 4 and 24 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Edmond et al.* in view of *Nakamura et al.* and further in view of *Powell et al.* Favorable reconsideration of this rejection is earnestly solicited.

Powell et al. is cited by the Examiner for its disclosure of the orientation of silicon carbide crystal. However, *Powell et al.* fails to provide the teachings which *Edmond et al.* and *Nakamura et al.* lack, as discussed above.

Claims 6 and 7 were rejected under 35 U.S.C. §103(a) as being unpatentable over *Edmond et al.* Favorable reconsideration of this rejection is earnestly solicited.

The Examiner acknowledges that *Edmond et al.* fails to teach the substrate having a top surface separated from a bottom surface of the active layer by a distance of about $1.6\mu\text{m}$. The Examiner argues that the specification does not contain disclosure discussing any critical nature of the claimed ranges or unexpected results arising therefrom.

However, the second embodiment of the invention discusses the criticality and unexpected results associated with this value. The discussion of the second embodiment of the invention begins on page 29, line 18, of the specification, and results are illustrated in Fig. 7.

It is by no means a predictable matter that the laser oscillation threshold is changed depending on the distance between the bottom surface of the active layer and the top surface of the substrate as set forth in claim 6. The inventor of the present invention for the first time discovered that such a relationship exists as represented in FIG. 7 and its related explanation. In the absence of such a knowledge, the person skilled in the art would never have been motivated to the subject matter of the present invention as set forth in claim 6.

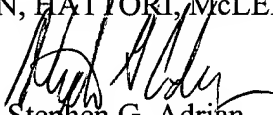
For at least the foregoing reasons, the claimed invention distinguishes over the cited art and defines patentable subject matter. Favorable reconsideration is earnestly solicited.

Should the Examiner deem that any further action by applicants would be desirable to place the application in better condition for allowance, the Examiner is encouraged to telephone applicants' undersigned attorney.

In the event that this paper is not timely filed, applicants respectfully petition for an appropriate extension of time. The fees for such an extension or any other fees which may be due with respect to this paper, may be charged to Deposit Account No. 01-2340.

Respectfully submitted,

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Attachments: Version with markings to show changes made
Request for Approval of Drawing Changes (Fig. 1)
Submission of Formal Drawings
Petition for Extension of Time

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IN THE CLAIMS:

Claim 1 has been amended as follows:

1. (Amended) An optical semiconductor device, comprising:

a substrate of SiC having a first conductivity type;

a buffer layer of AlGa_N formed on said substrate epitaxially, said buffer layer having said first conductivity type and a composition represented by a compositional parameter x as Al_xGa_{1-x}N;

a first cladding layer having said first conductivity type, said first cladding layer being formed on said buffer layer epitaxially;

an active layer formed epitaxially on said first cladding layer;

a second cladding layer having a second, opposite conductivity type, said second cladding layer being formed on said active layer epitaxially;

a first electrode provided so as to inject first-type carriers having a first polarity into said second cladding layer; and

a second electrode provided on a bottom surface of said substrate so as to inject second-type carriers having a second polarity,

said buffer layer containing said first type carriers with a concentration level in the range from $3 \times 10^{18} \text{cm}^{-3}$ to $1 \times 10^{20} \text{cm}^{-3}$ and said compositional parameter x larger than 0 but smaller than 0.4 ($0 < x < 0.4$).